## PROBABILITY OF RAIN IN SUMMER AT ATLANTA, GA.

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[Dated: Weather Bureau, Atlanta, Ga., Oct. 23, 1919.]

In a paper on the probability of rain in summer, Bruno Rolf[1] has advanced a method of forecasting from local conditions, whose application to the conditions observed at Stockholm meets with success in 68 per cent of the predictions.

Observed pressure is taken as the chief argument and by combination with other elements such as relative humidity, cloudiness, and wind direction he has derived curves of probability of rain, which he designates barombrometric curves or barombrograms.

The method of derivation in his work is largely mathematical and can not be entered into here, but it may be interesting to give some tables somewhat similar to his showing the probability of rain at Atlanta, using as arguments wind direction, pressure, pressure change, and relative humidity.

In this investigation the wind direction is taken as the chief argument, since it is believed to be one of the most important at any season and because of the slight variations in pressure in summer probably the most important factor in this region. For the first test the east wind was chosen. The a. m. observation is made the basis of the forecast, and the 12-hour period beginning at 7 p. m. is taken as the period for verification.

*Probability of rain in summer at Atlanta, Ga., based on records from June to August, 1890-1919.*

EAST WIND.

| | | |
|---|---|---|
| Wind observed from the east (7 a. m.) | times.. | 415 |
| Rainfall 0.01 inch or more, 7 p. m. to 7 a. m. | times.. | 90 |
| Probability of rain | | 0.22 |

TABLE 1.—*Pressure.*

| Observed pressure. | Number of times. | Probability of rain. |
|---|---|---|
| Below 30.01 | 63 | 0.24 |
| 30.01-30.10 | 160 | .22 |
| 30.11-30.20 | 145 | .21 |
| Above 30.20 | 47 | .19 |

TABLE 2.—*Relative humidity.*

| Percentage. | Number of times. | Probability of rain. |
|---|---|---|
| Below 71 | 71 | 0.10 |
| 71-80 | 89 | .18 |
| 81-90 | 123 | .20 |
| 91-100 | 132 | .33 |

TABLE 3.—*Pressure change.*

| Change. | Number of times. | Probability of rain. |
|---|---|---|
| Rise 0.10 or more | 62 | 0.16 |
| Rise 0.08 or 0.09 | 38 | .13 |
| Rise 0.06 or 0.07 | 39 | .20 |
| Stationary | 234 | .23 |
| Fall 0.06 or 0.07 | 19 | .26 |
| Fall 0.08 or 0.09 | 12 | .25 |
| Fall 0.10 or more | 11 | .54 |

[1] Probabilité et prognostics des pluies d'été, Upsala, 1917, vii, 25, [2] p., charts, tables. A translation has been prepared and placed in the Weather Bureau Library.

TABLE 4.—*Pressure change—Relative humidity—Probability of rain 7 p. m. to 7 a. m.*

| Relative humidity. | Pressure rise 0.06 or more. | Pressure stationary. | Pressure fall 0.06 or more. |
|---|---|---|---|
| Below 71 | [1] $0.03_{29}$ | $0.09_{82}$ | $0.30_{10}$ |
| 71-80 | $.07_{28}$ | $.20_{49}$ | $.33_{12}$ |
| 81-90 | $.15_{40}$ | $.20_{73}$ | $.36_{11}$ |
| 91-100 | $.33_{42}$ | $.32_{81}$ | $.33_{9}$ |

Subscripts indicate number of times observed.

TABLE 5.—*Observed pressure—Relative humidity—Probability of rain 7 p. m. to 7 a. m.*

| Relative humidity. | Pressure. | | | |
|---|---|---|---|---|
| | Below 30.00. | 30.01-30.10. | 30.11-30.20. | Above 30.20. |
| Below 71 | $0.00_{6}$ | $0.10_{31}$ | $0.18_{22}$ | $0.00_{12}$ |
| 71-80 | $.29_{17}$ | $.25_{28}$ | $.13_{31}$ | $.00_{13}$ |
| 81-90 | $.14_{22}$ | $.22_{64}$ | $.15_{41}$ | $(.50)_{9}$ |
| 91-100 | $.39_{18}$ | $.28_{47}$ | $.33_{51}$ | $.38_{16}$ |

TABLE 6.—*Observed pressure—Pressure change—Probability of rain 7 p. m. to 7 a. m.*

| Pressure change. | Pressure. | | | |
|---|---|---|---|---|
| | Below 30.00. | 30.01-30.10. | 30.11-30.20. | Above 30.20. |
| Rise 0.06 or more | $0.17_{13}$ | $0.14_{63}$ | $0.12_{56}$ | $0.25_{28}$ |
| Stationary | $.17_{36}$ | $.27_{108}$ | $.23_{77}$ | $.11_{19}$ |
| Fall 0.06 or more | $.47_{15}$ | $.13_{15}$ | $.46_{11}$ | $.00_{1}$ |

Table 1 shows that with east wind the observed pressure gives a slight indication of the probability of rain, but considering the general probability of 0.22 it may be neglected.

Relative humidity is a far better index, and taken in connection with observed pressure seems to be an excellent one with high humidity and low pressure.

From Table 3 it is evident that pressure change is by far of the greatest significance. A comparison of Tables 2 and 4 shows the lowering effect of pressure rise with low humidity and the uniform effect of pressure fall regardless of relative humidity.

Since these tables refer only to east winds at this station it is not permissible to draw general conclusions as to the probability of rain using pressure as the chief argument, but with the winds under consideration it is plain that the observed pressure is by no means a useful index as to rain in summer.

## KALTENBRUNNER'S STATISTICAL METHOD OF FORECASTING.

By ALBERT PEPPLER.

[Abstracted from Das Wetter, September-October, 1918, pp. 133-136.]

A statistical method of weather forecasting, based upon the sequence of weather for a large number of years, was published in 1914 by Kaltenbrunner. The idea underlying his work was that the weather of to-day is a function of the weather of yesterday; or, "similar weather follows similar weather factors." The so called weather factors are wind direction, state of weather, and current pressure at observation (2 p. m.); barometer change in preceding six hours; current temperature and humidity, the latter only in winter.

Schneider[1] gave the Kaltenbrunner method nine months unprejudiced trial at Vienna, with the surprising result that the forecasting from the weather map gave 75 and 62 per cent, respectively, for cloudiness and precipitation, while the statistical method gave 82 and 76 per cent, being an improvement of 7 and 14 per cent, respectively.

These tables have a practical significance not only for the layman, who may, with a few simple and inexpensive instruments, be able to make local forecasts; but also for the scientific forecaster, who may use it, together with the weather map which shows the broader distribution of weather elements, as a very valuable accessory.—*C. L. M.*

## INFLUENCE OF THE SEASONS AND WINDS ALOFT ON THE VARIATIONS OF ATMOSPHERIC PRESSURE AND WIND VELOCITY.

By G. Reboul and L. Dunoyer.

[Abstracted from Comptes Rendus, Paris Acad., May 12, 1919, pp. 947-949.][2]

A remarkable degree of accuracy is obtained in forecasting the variations of barometric pressure and wind velocity by means of variations of the winds aloft. The problem is considered first in the case where successive soundings of the upper air show increasing or decreasing wind speeds. A year of observations indicate that the following coefficients of certainty obtain under different conditions:

| Season. | Winds increasing with successive soundings accompanies or precedes falling barometer. | Winds decreasing with successive soundings accompanies or precedes rising barometer. | Winds constant with successive soundings accompanies or precedes stationary barometer. |
|---|---|---|---|
| Summer | 0.79 | 0.53 | 0.76 |
| Winter | 0.90 | 0.90 | 0.94 |

Similarly, comparing pressure changes and changes of wind intensity and classifying by wind direction, it is found that the average coefficient of certainty is 0.68 in the case of winds from N., NE., or E.; while it is 0.84 in the case of winds from any other direction. It is pointed out in this connection that the SW. winds are the moist ones, whereas the NE. are the dry winds, and that the moisture bearing qualities of these winds play an important part in pressure distribution.

In considering the case in which there are large differences of wind speed between upper and lower layers of the atmosphere, it is found that the following coefficients of certainty exist:

| Season. | Strong winds aloft followed or accompanied by fall of barometer. | Gentle winds aloft followed or accompanied by rise of barometer. | No change aloft and barometer stationary. |
|---|---|---|---|
| Summer | 0.75 | 0.53 | 0.60 |
| Winter | 0.82 | 0.78 | 0.85 |

Again classifying by wind direction we find about the same average values as in the first case, 0.65 and 0.80 for N., NE., and E. and other directions, respectively. Thus, the value of this method of forecasting barometric variations is better for SW. winds than for NE.—*C. L. M.*

## ON THE FORECASTING OF WEATHER BY MEANS OF FORECASTING TOTAL AMOUNT OF BAROMETRIC CHANGE.

By Gabriel Guilbert.

(Abstracted from Comptes Rendus, Paris Acad. Aug. 11, 1919, pp. 295-298.)

As is well known, the controlling factors of good and bad weather lie in the distribution of high and low pressure. Clouds and other devices for forecasting variations of pressure are, therefore, of great value. Several rules have been deduced for this purpose:

1. Wind movement in excess of normal is a prognostic of a rise of pressure, generally proportional to the magnitude of departure from normal.

When there are violent winds throughout the formation, both on the periphery and in the center, the maximum rise of pressure will result; sometimes as great as +30 mm. This value decreases with decrease of wind intensity until a stationary barometer is reached with a normal wind.

2. Wind movement less than normal indicates a fall of pressure, generally proportional to the magnitude of the departure from normal. The uniting of all causes of pressure fall may reduce the barometer by about 40 mm. in France. The greatest fall in 24 hours, 42 mm., was observed on December 8, 1886.

This method [it is claimed by M. Guilbert] is accurate enough to forecast the pressure fall or rise, in the majority of cases, to 1 mm.

[Note: The difficulties in forecasting European weather, which are made apparent in the running discussion in *Comptes Rendus*, between MM. Dunoyer and Reboul on one side, and M. Guilbert on the other, are due to the lack of sufficient ocean reports and to the small size of the European countries, compared with the size of the pressure formations. Hence these difficulties are not so in evidence in America.]—*C. L. M.*

[1] R. Schneider: "Kaltenbrunner's statistische Methode der Wettervoraussage," Met. Zeit. vol. 34, 1917, pp. 239-246.
[2] See another abstract in *Sci. Abs.*, Aug. 31, 1919, p. 362.